MEMORANDUM

TO: CHEROKEE COUNTY PARTICIPANTS REF: 1091C/890818

FROM: MARK J. LOGSDON (ABC)

RE: **TRANSMITTAL OF FINAL ROI**

DATE: August 18, 1989

Attached is the final transmittal package for the Pilot Testing Program. Two copies of the Final ROI and the cover letter were sent to Glenn Curtis (EPA/VII) by Federal Express on Friday, August 18, 1989.

If you have questions about this memo, the final product, or project status in general, please contact me.

Business Office: 303/399-9630
Home Office: 303/322-2399

AMAX Mineral Resources Company
1707 Cole Boulevard
Golden, CO 80401-3293
303 234-9020

AMAX Minerals + Energy

August 18, 1989 Ref: 1091C/890818

US EPA, Region VII
726 Minnesota Avenue
Kansas City, Kansas 66101

VIA FEDERAL EXPRESS

Attn: **Mr. Glenn Curtis**

Re: **FINAL REPORT OF INVESTIGATIONS: PILOT LEACH TESTING**

Dear Mr. Curtis:

Attached please find the Final Report of Investigations, "Pilot Leach Testing - Galena Subsite, Kansas" describing the pilot leach testing program undertaken by Adrian Brown Consultants on behalf of the participating PRP group. The report describes the program, presents the data, and evaluates the likely impact of the Additional Alternative in terms of water quality. The final report addresses the comments provided by EPA Region VII on the draft reports of June 30 and July 27, 1989 and incorporates the final data reports of the project.

The Participating PRPs submitted the draft report on June 30, 1989, as had been agreed with EPA Region VII. This Final Report of Investigations, which has been prepared as a contractor report to the Participating PRPs, completes the deliverables required by the April agreement.

The major technical conclusion of the pilot tests is that, within a few pore volumes of the initiation of flow, the leachate from the flow-through tests returned to steady values typical of starting water and well within the 1989 baseline range of starting waters. Therefore, based on these tests, selective placement of materials in exposed ground water at the Galena Subsite should have no negative effect on long-term water quality. When combined with other aspects of the Additional Alternative, improvement in overall water quality, particularly of the local streams, may be achieved.

There are some matters raised in the Draft Report of Investigation that were removed from the Final ROI in response to EPA comments that they were outside the scope of the actual pilot testing and therefore not suitable for inclusion in a report of those investigations. Nonetheless, the PRPs and our technical consultants consider that these matters are of technical substance and merit in viewing the overall selection of remedy, and we consider that they should be raised in this transmittal letter.

There are four principal matters that we wish to identify:

1. The PRPs consider that the data show the waste materials on the ground surface are not the cause of the low pH and elevated levels of metals and other dissolved solids observed in shallow ground water wells in the Galena area.

   As was pointed out in the Phase I Remedial Investigation (RI) (1) and Spruill (2), despite the geographical correlation of abandoned mines and mineralized ground water, the causal connection between mining wastes and ground water "contamination" is tenuous. In the RI, zinc is the only indicator parameter that could be shown statistically to be elevated in drinking water wells located down gradient of mine workings and wastes; no statistically discernible increase over baseline ranges was observed for cadmium, lead, iron, or net alkalinity (RI, Pages 46 to 49; Figures 4-7 to 4-9). The lack of covariance between zinc and the other indicator species to be expected from the EPA conceptual model of acid generation and metals dissolution suggests that the situation is not as simple as postulated in the RI.

   The new data of this study provide further evidence against a simple causal connection between mining wastes and shallow ground water degradation. All 8 of the ponds that were sampled in this baseline study are surrounded by mining wastes, yet the range of observed water quality, as shown in Table 3.7, is large. Consider the differences in water quality between Pond 41 and the Blue Hole, which are located less than 100 meters apart in Area 4. Pond 41, evidently a subsided shaft based on its form and the characteristics of the surrounding waste materials, has a pH of about 7, conductivity of about 530 umho/cm, low dissolved oxygen, and low to non-detectible values of metals. In contrast, the Blue Hole, also a subsided mining feature, has a pH of about 3.5, conductivity of about 370 umho/cm, relatively high dissolved oxygen (based on laboratory measurements of oxidation-reduction potential (ORP)), and dissolved metals in the tenths of parts per million (Cadmium) to a few parts per million (lead and zinc).

   Furthermore, in the batch and flow-through tests reported as part of this program and in the 1988 laboratory-scale testing, the leaching of waste materials did not generate acidity. In all cases, the pH of the leachate was above 5.5 su. In the 1989 studies reported here, the pH of the solutions rose from as low as 3.5 to as high as 6.5 in some tests. The Final Report documents that this is related to the presence of carbonate minerals in both the waste rock and the chat.

Thus, the test leaching data are not consistent with the hypothesis of acid mine drainage (AMD) developed by natural leaching of these materials, either on the surface or if moved to flooded subsidence features. Similarly, long-term leaching (as simulated in the flow-through tests) produces dissolved metals concentrations that are indiscernible (in the formal, statistical sense) from the concentrations in the starting waters.

Rather than hypothesize a causal connection between mining wastes (or even mining activity) and degradation of shallow ground water quality (if any such degradation exists), the evidence can be formulated better in terms of a common-cause connection (e.g., Reichenbach (3)). In the common-cause formulation, mining and mining waste, on the one hand, and ground water with elevated levels of metals, on the other hand, are each causally related to the presence of mineralized ground. Evaluation of ambient data, geochemical modeling, and evaluation of baseline water quality around other, recently discovered (but undeveloped) Pb-Zn deposits such as Red Dog in Alaska have been presented by Angino (4). The Angino report shows that there are compelling geochemical reasons to believe that ground water recharging to and flowing through the mineralized and fractured ground of the Galena ore field (even without mining) would produce, at least locally, acid waters and elevated levels of sulfate, total dissolved solids and dissolved metals. In light of this information, the effects of natural mineralization of the area (including fracturing, brecciation, and silicification, as well as sulfide mineralization) are the common cause of the mining/mining waste and the observed water quality.

2. The 1989 pilot program tested the likely effect of the leachate on shallow ground water. When the decision criterion is water quality of the shallow aquifer due to the placement of waste materials in the saturated zone, the conclusion of the pilot testing is that long-term, post-emplacment water quality is expected to be the same as the current water quality, though years of effort and millions of dollars in cost (based on the 1989 OUFS Supplement) will have been expended to move the waste materials.

   Based on the lack of discernible difference in projected water quality, the current test data are equally compatible with a no-action alternative for surface waste materials in

terms of likely impact on shallow water quality. As discussed above and extensively in the Final Report of Investigations, other aspects of the Additional Alternative (particularly remediation of current stream capture) may provide for overall improvement in water quality, but these aspects were not tested directly by the ABC pilot testing program. The principal reduction in solute loadings derived by the analysis of Appendix E of the 1989 OUFS Supplement comes from the rechannelization of surface water drainage that is currently captured by subsidence features. As has been shown elsewhere in the Tri-State district, stream capture can be addressed by simple remedial measures that do not require use or handling of significant volumes of surficial material. Based on the analysis done by EPA, the remediation of the surficial drainage would accomplish all that the much more elaborate subsurface disposal proposes to accomplish relative to water quality, given the results of the 1988 and 1989 leach testing programs.

3. If some form of the Additional Alternative is selected, materials handling of the waste rocks may be important to detailed planning for a cost-effective remedial action. In particular, screening of waste rock should be examined in terms of the data provided by the ABC batch testing results (Section 3.2 of the final report) to determine the benefits of this step to overall projected performance. The batch tests of the 1989 pilot testing program indicate that mass loadings of metals using unscreened waste rock likely would provide for no long-term degradation of water quality in the shallow aquifer. Based on the data of Tables 3.9 and 3.10 and Figure 3.1 of the Final Report, the PRPs consider that:

   a) The apparent elevation in leachable metals from using unscreened waste rock and chat is small. Compare the results of Batch Test 1 (2:1 water/rock ratio with water 524/ plus 2-inch screened siliceous waste rock and chat) with Batch Test 3 (2:1 water rock ratio with water 524/ unscreened siliceous waste rock and chat). In the unscreened test, the net change in concentration of lead (post leaching concentration compared to pre-leaching concentration; Table 3.10) is greater by 0.26 mg/l and cadmium is greater by only .03 mg/l. The changes in zinc and sulfate concentrations are actually lower (by 2.2 and 60 mg/l, respectively) in the case on the unscreened waste rock than in the case of the screened waste rock.

   b) The resultant batch leachate concentrations fall within the 1989 baseline range; compare Table 3.9 with Table 3.8.

c) The flow-through tests show that the long-term water quality is not a function of the total metal content of the rock or even of the short-term leachability of the rock-chat mixtures, but rather is related to the chemistry of the influent water.

In these circumstances, we consider that that benefit of the screening step in terms of long-term water quality has not been demonstrated.

Similarly, we consider that the field scale implementation of the Additional Alternative should strive to minimize all materials handling steps in order to minimize the potential for abrasion between waste materials. We appreciate that some degree of mixing and rock-to-rock movement is inevitable and also that testing has shown the materials to be extremely hard. Nonetheless, our experience with materials handling - like that of our consultants - is that abrasion (and hence the formation of fresh faces that may be more leachable) increases as materials handling increases. Thus, any steps that minimize materials handling will likely minimize the short-term water-quality impacts observed in the 1989 pilot leaching program. The minimum impact on short-term leachability would occur from taking a no-action approach to surface wastes, using other approaches to diverting current surface-water capture as the mechanism for improving long-term water quality.

4. Based on the results of the testing programs and our understanding of the Additional Alternative, the PRPs consider that even if the full scope of the Additional Alternative were invoked, there would be no need for special handling of materials that would be moved to subsidence features above the water table or to exposed ground water in major subsidence features that have pH above about 5.5 water under current conditions, as the EPA concern is related to leaching of fine-grained materials in acidic waters. That is, moving waste materials to dry holes or to ponds such as ponds 41 (pH = 7.1); 617 and 720 (pH = 6.9), and even ponds such as 14 (pH = 6.1) does not require either screening or geochemical characterization and segregation.

I trust that you will find this letter and the Final Report of Investigations acceptable and will incorporate their data, analyses and conclusions into the adminisitrative record of EPA decision making for the Galena Subsite. If you have questions about this letter or the Final Report of Investigations, please contact Mr. Kenneth Paulsen of AMAX Mineral Resources, who will field comments and questions on behalf of the Participating PRPs.

Nothing in this letter or the Final Report of Investiagtion by Adrian Brown Consultants may be considered an admission or waiver of any defense by any or all of the PRPs concerning liability for response costs or concerning the propriety of U.S. Environmental Protection Agency's actions at the Cherokee County site as a whole or the Galena subsite in particular.

Sincerely,

Kennth R. Paulsen

On Behalf of:

AMAX Inc.
ASARCO
E.I. DuPont de Nemours & Co.
Gold Fields Mining Corporation
NL Industries
Sun Comapny

References:

(1) EPA, 1986. Final Draft, Phase I Remedial Investigation Report - Cherokee County, Galena Subsite. EPA Document No. 127.7LB9.0, April 23, 1986.

(2) Spruill, T.B., 1984. Assessment of Water Resources inLead-Zinc Mined Areas in Cherokee County, Kansas, and Adjacent Areas: U.S. geological Survey Open-File Report 84-439

(3) Reichenbach, Hans, 1956. The Direction of Time. Berkeley, University of California Press.

(4) Angino, E.E., 1984. Premining Surface and Shallow Ground WaterQuality in the Viciniy of Short Creek, Galena Kansas. Report to Environmental Managment Services Co., Fort Collins, Colorado. Submitted to EPA by AMAX Mineral Resources for certain PRPs by letter from P. Keppler (AMAX) to A. Fuerst (EPA/VII, dated March 22, 1988

cc: K. Paulsen; P. Keppler (AMAX)
J. Richardson (ASARCO)
S. Wilson (DuPont)
G. Upphof (EMS)
A. Godduhn (Gold Fields American)
B. Sams (NL)
M. Bernstein (Skadden Arps)
L. Grossi-Tyson (Sun)